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(54) **Method for forming multi-coloured porcellainized ceramic stone tiles by extrusion**

(57) A method for forming tiles or tile accessories of  
extruded porcelainized ceramic stone, comprises the op-  
eration of preparing at least two pastes, typologically de-  
fined as porcelainized ceramic stone, having different  
colours; feeding said at least two pastes directly into the  
chamber of a screw extruder (6); subjecting the mass

advancing within the extruder (6), downstream of the  
screw (7) and upstream of the die (13), to the action of  
at least one flow deviator means (9, 10, 11, 12); sepa-  
rating portions corresponding to tiles or tile accessories  
such as steps or skirting; subjecting the tiles or tile ac-  
cessories obtained in this manner to a drying cycle; sub-  
jecting the dried tiles or tile accessories to a firing cycle.

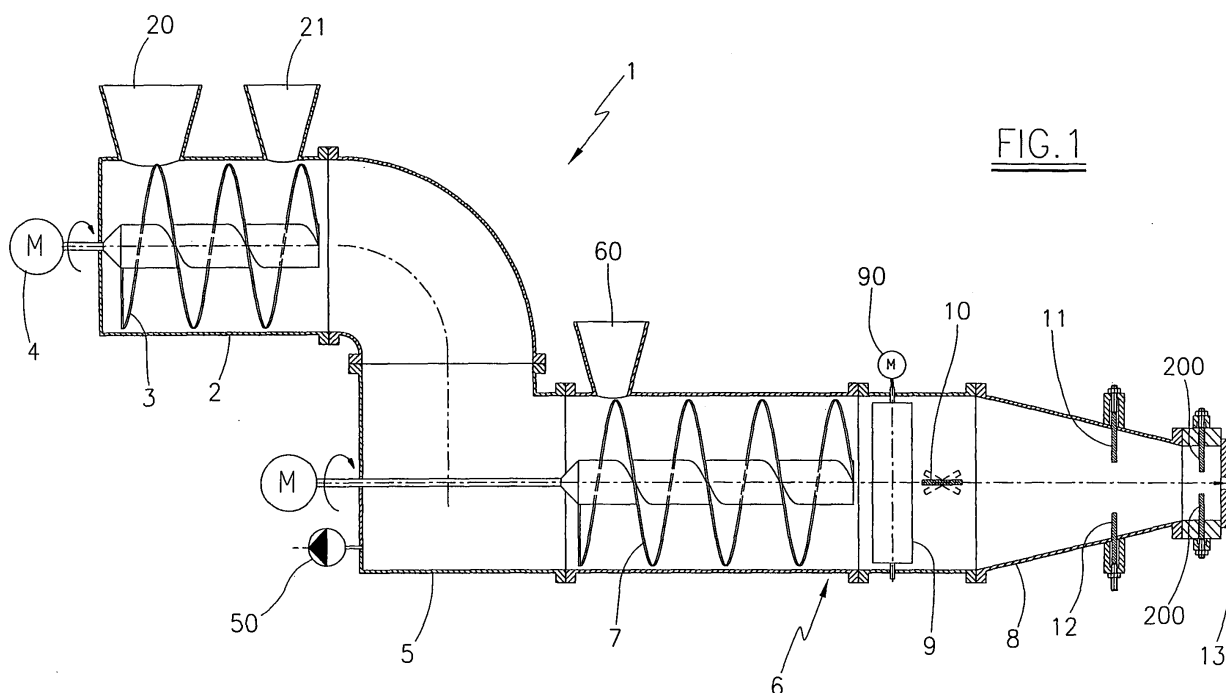


FIG. 1

## Description

**[0001]** This invention relates to a method for manufacturing bulk-coloured multicoloured porcellainized ceramic stone tiles by extrusion.

**[0002]** Said tiles result from irregular but controlled mixing of various types of different-coloured pastes, which are fed to the forming mould partly mixed, to give rise to adjacent co-penetrating masses of different colours and geometrical shapes in the extruded tile.

**[0003]** Various systems and plants exist for forming such tiles, the intention of which is generally to reproduce marble veining.

**[0004]** In all known systems, the porcellainized ceramic stone tile is formed dry, by pressing powders in a mould followed by firing.

**[0005]** With these known systems, mutually copenetrating irregular veins can be reproduced, interspaced within coloured masses to imitate many types of marble.

**[0006]** Plants are also known for forming terracotta or ceramic stone tiles by extrusion. These plants enable tiles to be formed which are of a single colour or at the most have a decoration imitating natural wood, consisting only of undulated dark veining in a lighter matrix, or vice versa.

**[0007]** US-A-4,292,359 discloses a process for the continuous production of partly finished clay product, comprising the step of feeding a base material to a first screw extruder having two screw conveyors in series separated by a degassing chamber, and feeding a second, differently colored material to the degassing chamber.

**[0008]** Up to now it has not been possible to manufacture extruded tiles with those types of decoration in which veining extends as volutes wrapping about themselves or as striated stains comprising different coloured curls.

**[0009]** These latter types of decoration are typical of many varieties of marble.

**[0010]** The object of the invention is to provide a method able to form by extrusion porcellainized ceramic stone tiles provided with these types of decoration.

**[0011]** This object is attained according to the invention by wet-forming the powders by extrusion and operating on the interior of the extruder to compel the extruding material to undergo a more or less tortuous path before reaching the die.

**[0012]** According to the invention, the material to be extruded is a powder paste of water content sufficient to provide it with the necessary flowability for its advancement through the extruder and its passage through the die, and to ensure sufficient consistency after extrusion.

**[0013]** According to the invention, a convenient water content is between 15% and 27%.

**[0014]** The extrusion screw is fed with at least two masses of different colour, each consisting of a parcelainized ceramic stone paste coloured by the known method.

**[0015]** These masses are firstly mixed so that they co-

penetrate but do not mix completely, and are then fed to the screw of a usual extruder where they assume the shape of elongate irregular bodies or streams, the at least two masses being generally parallel to each other.

**[0016]** To obtain the desired appearance, according to the invention the material is subjected in the converging portion of the extruder downstream of the screw to the action of deflector or barrier means for deviating the flow, in order to introduce irregularities in the mutual distribution of said elongate masses, so giving them the desired appearance.

**[0017]** The material leaves the die in the form of a consistent web, which is then separated into sections each of which constitutes a tile.

**[0018]** The wet tiles obtained in this manner are subjected to a drying process with a thermal cycle depending on their degree of wetness and the thickness of the extruded tiles, after which the tiles are fired by the usual methods for porcelainized ceramic stone.

**[0019]** The partial mixing of the various pastes is done both upstream of the extruder within a screw mixing device, in which the water content is also adjusted to the required value, and in the extruder chamber.

**[0020]** Material compacting is facilitated between the screw mixer and the extruder by the provision of a vacuum chamber.

**[0021]** In certain embodiments of the invention the pastes can be mixed directly in the vacuum chamber, suitable means being provided for injecting the coloured pastes directly into said chamber.

**[0022]** The deflector means of the invention consist of at least one barrier movable about a diametrical axis of the extruder, so that it can be set parallel to this axis or inclined to it.

**[0023]** Said means of the invention also preferably comprise at least one barrier, which is inserted to a desired extent into the extruder in a plane perpendicular to the axis.

**[0024]** According to a further embodiment, the invention comprises two adjustable coplanar barriers, perpendicular to the extruder axis, to define a cutting screen for the material flow, or a material passage port positioned outside the screw axis.

**[0025]** Said various deviator means or movable barriers can be used either individually or in combination within the same extruder.

**[0026]** The merits and the operational and constructional characteristics of the invention will be more apparent from the ensuing detailed description of a preferred embodiment of a plant for realizing the invention, with reference to the accompanying drawings.

**[0027]** Figure 1 is an axial section through the extrusion plant of the invention.

**[0028]** Figure 2 is an axial section through one embodiment of the terminal part of the extruder.

**[0029]** Figure 3 is an axial section through the terminal part of the extruder taken perpendicular to the preceding.

**[0030]** Figure 1 shows the plant for forming tiles by

the method of the invention.

**[0031]** The plant 1 comprises a first chamber 2 into which there open a pipe 20 for feeding the basic tile paste, and a pipe 21 for feeding the coloured pastes which are to form a part of the required decoration.

**[0032]** The basic paste used is a usual mixture of clear baking clay, feldspar and quartz.

**[0033]** The coloured pastes are prepared by adding coloured ceramic pigments to the basic paste.

**[0034]** The two pastes have a water content of between 15% and 17% and are fed into the chamber 2 by a conveyor belt system, not shown.

**[0035]** Inside the chamber 2 there is a screw mixer 3 of usual type operated by an electric motor 4, both to partly mix the two or more pastes so that they copenetrates to form a single stream of paste having at least one coloured vein, and to feed said paste stream to a second chamber 5 positioned downstream of the chamber 2.

**[0036]** A certain degree of vacuum is formed in the chamber 5 by a pump 50, to create a negative pressure which facilitates paste compaction.

**[0037]** The extruder 6 comprises a screw 7 arranged to transfer the paste from the chamber 5 to the compression cone 8, two movable barriers 9 and 10 being provided between the screw 7 and the compression cone 8.

**[0038]** The extruder 6 comprises a pipe 60 through which coloured paste is fed using a screw pump injection system, not shown, to achieve farther types of decoration.

**[0039]** The barriers 9 and 10 are positioned horizontally and vertically respectively, and are oscillated about their axes by two motors 90 and 100, to deviate the central axis of the paste stream.

**[0040]** The extent and frequency of the oscillations of the barriers 9 and 10 varies according to the type of decoration to be achieved.

**[0041]** Within the extruder cone 8 there are provided a further two coplanar adjustable barriers of guillotine type, inserted into the interior of the extruder cone in a plane perpendicular to the axis, to define a cutting screen for the material flow, or a flow passage port offset from the extruder axis.

**[0042]** The die 13 is positioned downstream of the extruder cone and comprises, for adjusting the extrusion geometry, the traditional upper and lower braking system 200 through which a paste web 30 emerges to be then extruded and cut into sections, each of which constitutes a tile.

**[0043]** Using the described plant 1 the method of the invention can be implemented.

**[0044]** Said method comprises preparing separately a basic tile paste of porcelainized ceramic stone and at least one coloured mix, then feeding them to the mixer 3 and/or to the screw 7, through the pipes 20, 21 and 60 respectively.

**[0045]** The water content of the paste is preferably between 15% and 27%.

**[0046]** The paste and the coloured mix are then par-

tially mixed so that they copenetrates each other to form a single paste stream having at least one coloured vein, and are then fed to the extruder 6, which can receive also a second feed of coloured paste through the pipe 60, and within which the movable barriers 9 and 10 deviate the central axis of said stream to display coloured veining like the marble veining.

The material can be optionally passed also through the barriers 11 and 12, which define for the paste a cutting port by which further coloured veining present within the stream is displayed.

**[0047]** The die 13 and relative braking system 200 are provided downstream of said barriers 11 and 12, to produce an exit web of paste which is divided into tiles by usual means.

**[0048]** The tiles obtained in this manner are then dried using a predetermined thermal cycle depending on the characteristics and thicknesses of the pastes used.

**[0049]** According to a variant of the invention, the coloured paste can also be injected directly into the chamber 5 by suitable material transfer means, such as usual screw pumps. In this manner the vacuum present in the chamber 5 facilitates the feed of the paste into the chamber, and its mixing with the pastes already fed into said chamber through the pipes 20 and 21.

**[0050]** Finally, further extrusion shapes such as steps, skirting, corner pieces and others can be obtained by changing the die 13.

## Claims

1. A method for forming tiles or tile accessories of extruded porcelainized ceramic stone, comprising the following operations:

- preparing at least two pastes, typologically defined as porcelainized ceramic stone, having different colours;
- feeding said at least two pastes directly into the chamber of a screw extruder (6);
- from the extruded web obtained in this manner, separating portions corresponding to tiles or tile accessories such as steps or skirting;
- subjecting the tiles or tile accessories obtained in this manner to a drying cycle;
- subjecting the dried tiles or tile accessories to a firing cycle;

## characterized by

- subjecting the mass advancing within the extruder (6), downstream of the screw (7) and upstream of the die (13), to the action of at least one flow deviator means (9, 10, 11, 12);
- said at least two pastes being subjected to the action of a mixer (3) before being fed to the extruder (6); and

- said at least two pastes being fed to said at least one flow deviator means (9, 10, 11, 12) in a partially and randomly mixed fashion.

2. A method as claimed in claim 1, **characterised in that** the flow deviator means (9, 10, 11, 12) is a barrier (9, 10) which can rotate about a diametrical axis of the extruder (6) to lie in a plane containing said axis or in a plane cutting said axis. 5 10
3. A method as claimed in claim 1, **characterised in that** the flow deviator means is a barrier (11, 12) which can be inserted into the extruder (6) by a desired amount in a plane orthogonal to the axis of the extruder (6). 15
4. A method as claimed in claim 3, **characterised by** comprising at least two coplanar barriers (11, 12) arranged to define a slot positioned outside the extruder axis. 20
5. A method as claimed in claim 1, **characterised in that** pastes of different colour are injected between the mixer device (3) and the extruder (6) by pumps or equivalent material transfer systems. 25
6. A method as claimed in claim 1, **characterised by** comprising, between the mixer device and the extruder, a chamber (5) maintained under vacuum to degas the mixed material. 30
7. A method as claimed in claim 1, **characterised in that** at least one coloured paste is fed into said chamber (5) by pumps or equivalent material transfer systems. 35
8. A method as claimed in claim 1, **characterised in that** the paste has a water content of between 15% and 27%. 40

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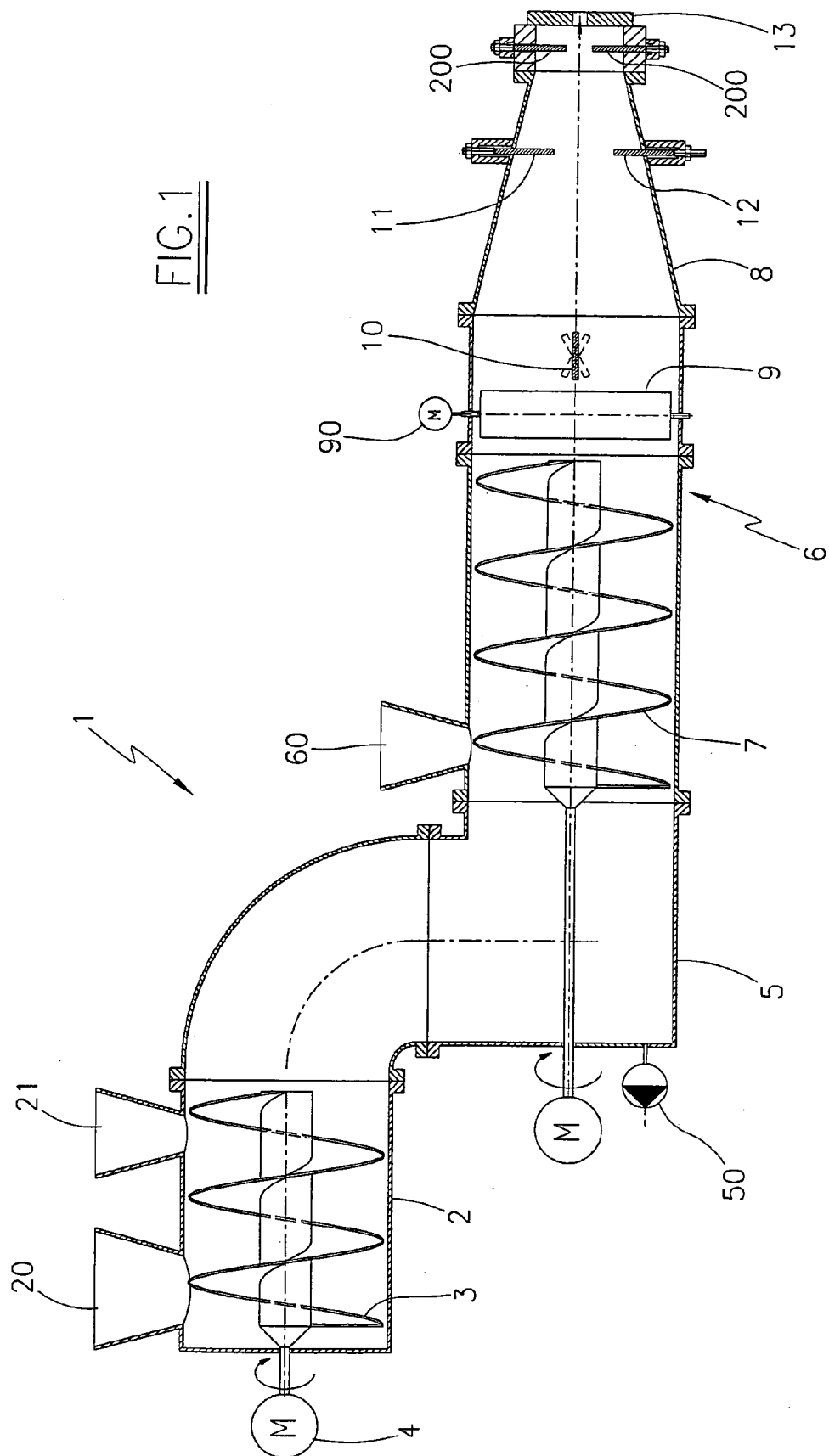


FIG.2

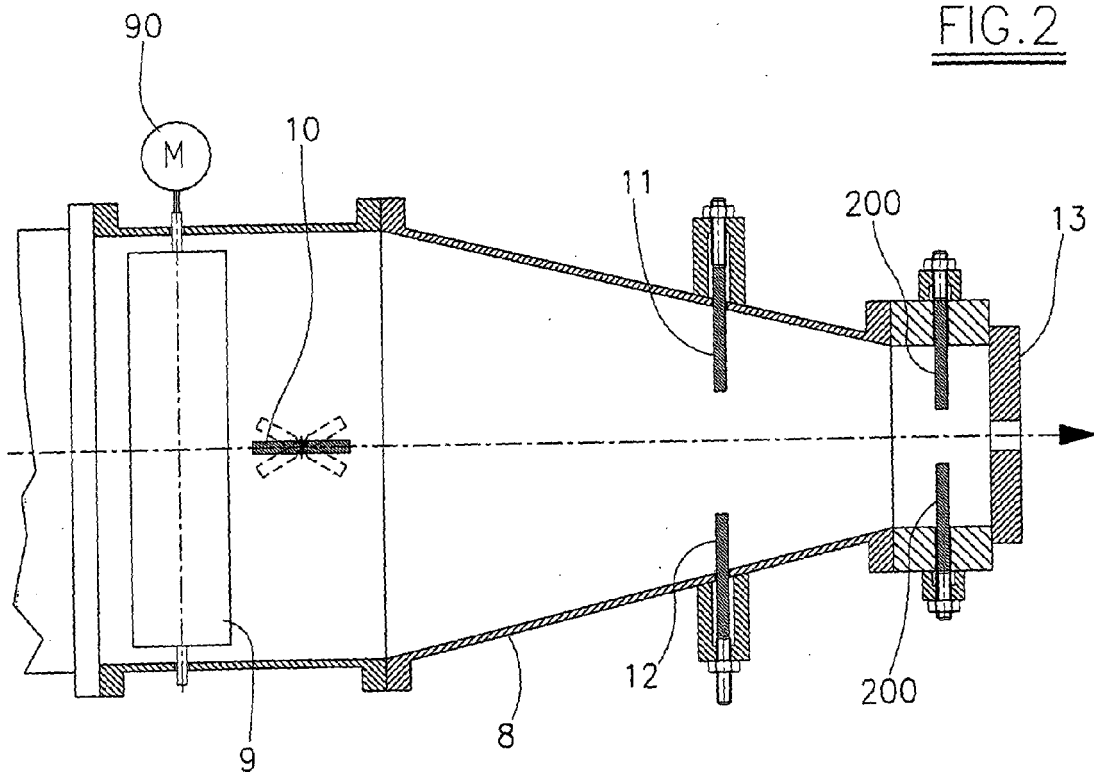
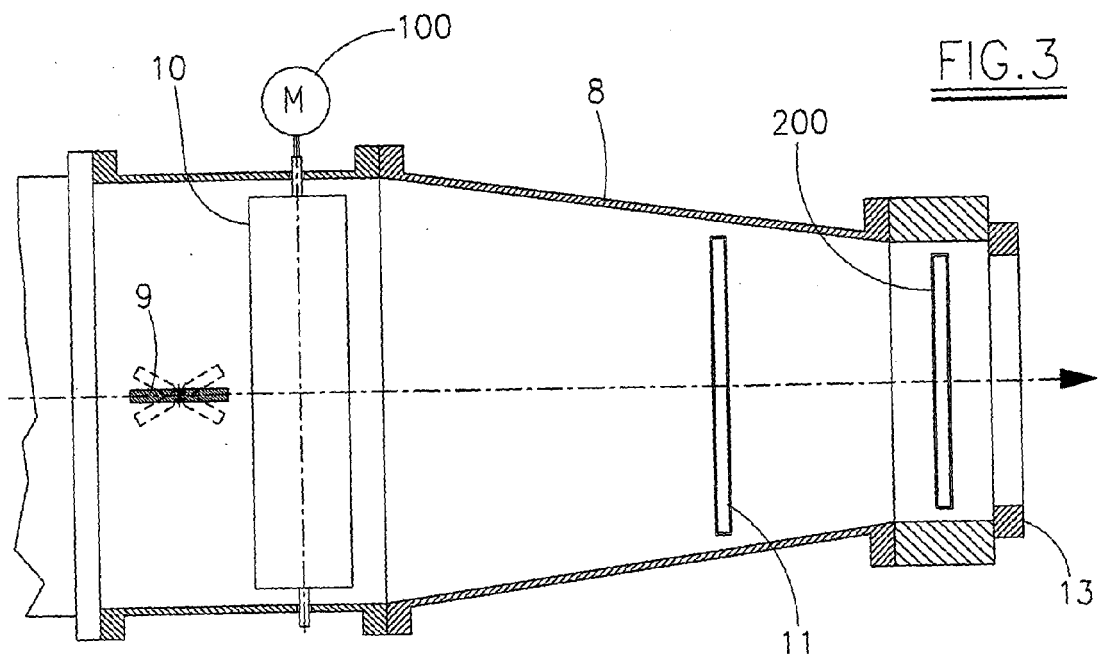


FIG.3



**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- US 4292359 A [0007]